GENERAL NOTES.

Stellar Parallax Work at the Yale Observatory.—The heliometer at the Astronomical Observatory of Yale University—the only instrument of its kind in this country—has been devoted principally to observations for determining the parallaxes of stars. Dr. ELKIN'S work on the Parallaxes of the Stars of the First Magnitude is recognized as one of the most valuable contributions to our knowledge in this difficult field.

It is generally known that another important piece of work, having for its object a more extended survey of fainter stars with large proper motion, has been in progress with this heliometer for some years, and the results have been looked for with great interest. They are now made public in Part I of Volume II of the Transactions of the Astronomical Observatory of Yale University, which is entitled "Parallax Investigations of One Hundred and Sixty-three Stars Mainly of Large Proper Motion." The great bulk of the work has been executed by Dr. CHASE, Assistant Astronomer, who has devoted to it the larger part of the past thirteen years; but Mr. MASON F. SMITH, Assistant, and Dr. ELKIN, the Director, have also taken part in it, the relative shares of the three observers being about as ten to two to one, respectively.

The Introduction describes the selection of the programme of work and the method of observation and reduction. It was at first planned to make only a few observations—three or four—at two successive epochs of maximum parallactic effect, it being assumed that these would be sufficient to show with certainty parallaxes as large as 0″.20 and to indicate values as large as 0″.10. The stars with large parallaxes were then to be observed more exhaustively. Later it seemed desirable to extend the observations over two more epochs taken in reverse order, to eliminate more completely the effects of proper motion and any systematic errors of observation. More stars were also added to the observing-list, including *Arcturus* (results not yet published), several red stars, for the determination of systematic error depending on star-color, and a number of stars selected by Dr. DE BALL, of Vienna, as the

material for a co-operative plan for a stellar parallax campaign based on stellar magnitude.

The results in the present investigation are made to depend solely on measures of distances, two comparison-stars being used, in general, for each star investigated. Every precaution was taken to avoid systematic errors of all kinds, and tests of various kinds were made to check the accuracy of the results.

The main part of the volume gives the details of the measures for each star, the equations of conditions, the normals and their solution, and finally the resulting relative parallax with its probable error. This is followed by a discussion of the observations on the red stars and a general discussion of the results of the parallax work. It is shown that there is a discernible effect on the distance-measures, due to the color of the star, "the mean light of the red star being apparently refracted less than that of the comparison-stars," but the effect is so small—probably not greater than 0″.03 for a highly colored star—that "any vitiation in the parallax results, due to this cause, is presumably well within their probable error."

The table of collected results shows that only two stars were found to have a parallax as great as 0″.20,—viz., 5 *Serpentis,* 5.1 magnitude, and *Lalande* 46650, 8.7 magnitude, —and that only thirty-eight show a parallax equal to 0″.10. In their general conclusions, the authors arrange their results in five tables, in order respectively of Proper Motion, Stellar Magnitude, Size of Parallax, Right Ascension, and Stellar Spectra. In the first, second, and fifth of these tables, Dr. ELKIN'S results for the Ten First-Magnitude Stars in the northern hemisphere are also included.

These tables are of great interest, and bring out clearly some important points. That there should appear, in Table I, a "distinct interdependence of parallax and proper motion" was to be expected. It is noted that the stars with proper motions exceeding 1″ give "uniformly positive and generally appreciable values" for the parallax.

The dependence of parallax upon magnitude is not so clearly brought out in Table II, but a small relation is indicated. More data are needed for the determination of this relation.

Table III emphasizes the connection between proper motion and parallax. Table IV indicates an interesting relation between the parallax and the Right Ascension of the stars,

though the proper motions here also show the same sequence. When the mean values are combined into quadrant groups we have:—

Right Ascension.	Proper Motion.	Parallax.	Number of Stars.	Average Magnitude.
0^h to 6^h	0″.73	0.065	42	6.3
6 to 12	0 .62	0.033	40	6.2
12 to 18	0 .83	0.064	40	6.4
18 to 24	0 .55	0.035	51	5.8

The possibility that a temperature effect might account for this sequence is considered by the authors, but they feel "measurably confident that the relation shown by Table IV is one of actual reality."

Finally, the fifth table fails to show much evidence for the law deduced by KAPTEYN of larger parallaxes for stars with Type II spectra than for stars of Type I; but classes F and H of Type II present marked divergences, the average values for the two being + 0″.079 and + 0″.023, respectively, with sensibly equal average proper motions.

The present writer was pleased to find that four binary stars having reasonably well-determined orbits were included in the list of stars with fairly well-determined parallax.

It may be of interest to give the masses and dimensions of those systems which result from combining these values of the parallax with the orbital elements given in *Lick Observatory Bulletin,* No. 84.

Assuming as units the year, the Earth's distance from the Sun, and the combined mass of the Earth and Sun, we have the formula: $\frac{a}{\pi} = P^{\frac{2}{3}} (m + m')^{\frac{1}{3}}$, when a denotes the semi-major axis of the binary orbit, P the revolution period, $(m + m')$ the combined mass of the two components, and π the parallax.

For the four stars in question we find:—

Star.	a''	P	π	$(m + m')$	a {astron. units.}
ζ Herculis	1″.35	$34^y.8$	0″.17	0.42	8
ξ Ursæ Majoris	2 .51	60 .0	0 .17	0.89	15
μ Herculis[1] BC	1 .37	45 .4	0 .12	0.72	11
85 *Pegasi*	0 .78	25 .7	0 .10	0.72	8

[1] The parallax is given for the bright star, *Mu Herculis*, but the micrometer measures show that the faint pair, BC, is physically connected with *Mu*, and it is hence assumed that its components have the same parallax.

So far as these figures go they indicate that the masses of binary systems are of the same order as that of the solar system. The dimensions of these four systems are comparable with those of the orbits of *Saturn* and *Uranus*.

It must be said that comparatively small changes in the values of the parallax and orbit elements result in large changes in the values of the mass and dimensions. Thus Miss CLERKE, using 0″.054 for the parallax of 85 *Pegasi* and SEE's elements ($a = 0''.89$, $P = 24^{y}.0$) finds $(m + m')$ equal to 11.

R. G. AITKEN.

Planetary Inversion.—The *Monthly Notices* of the Royal Astronomical Society for April, 1906, contain a very interesting and quite elaborate article on "Planetary Inversion," by F. J. M. STRATTON, of Gonville and Caius College, Cambridge. The work is an extension to the other planets of the solar system of Sir GEORGE DARWIN'S theory of tidal friction put forth a number of years ago to explain the evolution of the Earth-Moon system. The primary object of the investigation seems to have been to explain the apparently anomalous condition presented in the retrograde motion of *Phœbe,* the ninth satellite of *Saturn,* discovered some years ago by Professor W. H. PICKERING. The article is far too technical for the general reader to follow, but the author gives an excellent summary of three pages in non-technical language at the conclusion. The author has also written a brief extract, printed in the *Astrophysical Journal* for July, which is reproduced below with the omission of one paragraph.

"In view of the discussion between Professor MOULTON and Professor W. H. PICKERING in the number of the *Astrophysical Journal* for December last, perhaps a brief abstract of the results obtained by applying Sir GEORGE DARWIN'S theory of tidal friction to the question of planetary inversion may be of interest. It seems certain to be the case that if a planet unattended by any satellites has an initial retrograde rotation, its axis of rotation will, under the influence of tidal friction, tilt over until the planet reaches a position of stable equilibrium in which its rotation will be direct. The stable value for the obliquity will be somewhere between 0° and 90°, its exact value depending on the planet's viscosity, rate of rotation around its axis, and of revolution in its orbit.

"If satellites are introduced, the question becomes more complicated, and the stable value of the obliquity will vary with the different conditions as to the number of satellites, their masses, and mean distances. There will be three possible equilibrium values for the obliquity accord-

ing to different circumstances—values very near 0°, 90°, and 180°, respectively. *Jupiter* is certainly approaching the first of these values; assuming for it initial retrograde rotation, its satellite system must have been evolved after its obliquity had under the influence of tidal friction alone decreased to some value less than 90°. *Saturn,* on the other hand, evolved *Phœbe,* and possibly *Iapetus* and *Hyperion,* while its obliquity was still greater than 90°. As its obliquity approached this value, *Phœbe's* orbit moved down to the ecliptic (thus remaining retrograde), while *Iapetus* and *Hyperion* followed *Saturn's* equator over. Later on, the inner satellites were evolved, and under their influence and that of the ring *Saturn* is moving into a stable position of small obliquity. In the cases of *Uranus* and *Neptune,* lack of sufficient data makes it impossible to say with any accuracy what is happening, but it seems most likely that *Neptune* is being driven by its own satellite into a stable position with an obliquity of 180°. The obliquity of *Uranus,* too, is possibly being increased at present, but in this case the result is very doubtful.

"It remains to add that the theory is beset with many difficulties, such as the great extent of time involved and the double factor introduced by the heterogeneity of the planets. It does not, so far as I can see at present, explain the high obliquities of *Jupiter's* recently discovered satellites; but it is an hypothesis which does offer an explanation of the retrograde motion of *Phœbe* in its orbit, and of the retrograde rotations of *Uranus* and *Neptune.*"

The Committee on Bibliography and Astronomical Studies at the Royal Belgian Observatory has undertaken the task of preparing and publishing a list of the observatories and astronomers of the world. It is the intention to include in this list all those who are actively engaged in work for the advancement of astronomical knowledge, and all such who are not connected with any observatory to which inquiries have been addressed are requested to send to M. le Professeur Dr. P. STROOBANT, at the Royal Observatory of Belgium at Uccle, for an inquiry blank.

The following notes have been taken from recent numbers of *Science:*—

Professor HERMANN CARL VOGEL, director of the Astrophysical Observatory at Potsdam, has been elected a correspondent of the Paris Academy of Sciences, in succession to the late Dr. S. P. LANGLEY.

Professor JULIUS FRANZ, director of the Breslau Observatory, has been elected an associate of the Royal Astronomical Society.

Mrs. W. P. FLEMING, curator of astronomical photographs in the Harvard College Observatory, has been elected an honorary fellow of the Royal Astronomical Society. Mrs. FLEMING has also been appointed honorary fellow in the department of astronomy in Wellesley College, in recognition of her distinguished work in astronomy and in gratitude for her helpful co-operation in the establishment of astronomical work in Wellesley College.

Professor EDMUND WEISS, professor of astronomy in the University of Vienna, has been elected a corresponding member of the Paris Academy of Sciences in the room of the late O. STRUVE.

The astronomical fraternity mourns the loss of M. GEORGES RAYET, for twenty-five years director of the Bordeaux Observatory, whose death occurred on the 14th of June. The *Astronomische Nachrichten,* No. 4111, contains a brief account of his career, and the *Bulletin Astronomique* for August contains an account of exercises held in recognition of his eminent services to astronomical science.

Doctor's Degrees.—In *Science* for August 17th there is an article entitled "Doctorates Conferred by American Universities." During the last nine years 2,387 doctorates have been conferred, and of these 1,131 were taken in the sciences. Thirty-one degrees have been granted in astronomy, which stands ninth among the twenty-two sciences enumerated. Four doctorates in astronomy were conferred during the last academic year, as follows: By the University of Chicago, on DELONZA TATE WILSON, "Work on Minor Planets"; by the University of Pennsylvania, on SAMUEL GOODWIN BARTON, "Secular Perturbations Arising from the Action of *Saturn* on *Mars:* an Application of the Method of LOUIS ARNDT"; and on EDITH DABELE KAST, "The Mean Right Ascensions and Proper Motions of One Hundred and Thirty Stars"; by the University of California, on SEBASTIAN ALBRECHT, (I) "A Spectrographic Study of the Fourth Class Variable Stars Y *Ophiuchi* and T *Vulpeculæ,*" (II) "On the Distortion of Photographic Films on Glass."
